Not to be cited without
permission of the authors[1]

Ne pas citer sans
autorisation des auteurs[1]

DFO Atlantic Fisheries
Research Document 95/32

MPO Pêches de l'Atlantique
Document de recherche 95/32

Update on the Status of Unit 3 Redfish: 1994

by

R. Branton
Marine Fish Division
Bedford Institute of Oceanography
P.O. Box 1006, Dartmouth
Nova Scotia
B2Y 4A2

[1]This series documents the scientific basis for the evaluation of fisheries resources in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the secretariat.

[1]La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

Abstract

The document summarizes commercial fishery and research survey data for Unit 3 redfish during 1994. Most of the catch was taken by small otter trawlers (less than 65 feet) and was slightly higher than the previous year, but well below the TAC. The small trawler fishery started in April, peaked in July and closed at the end of August. Some very small redfish (less than 20 cm) were landed early in the season from the area north and east of Brown's Bank for use as lobster bait, but were avoided once the lobster season ended. Commercial catch rates have declined slightly but many changes in the fishery make these difficult to interpret. Present biomass, as judged from the 1994 survey is not greatly different than average since the late 1980s however there were increased numbers of small redfish particularly in area north and east of Brown's Bank. There is, as yet, no indication that this recruitment will result in a marked increase in the biomass but combined with the low exploitation rates which currently prevail, should result in fishing and stock conditions in 1996 being very much the same as in recent years.

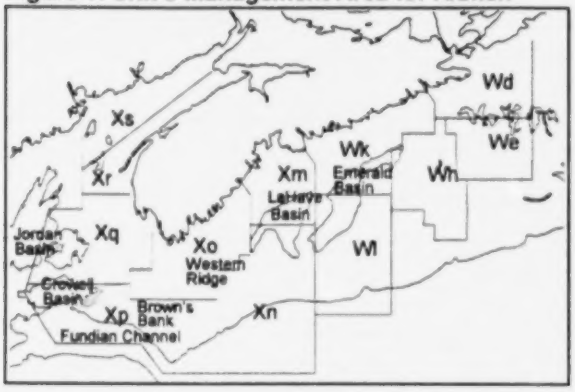
Résumé

Le présent document résume les données de la pêche commerciale et des relevés de recherche en ce qui concerne le sébaste de l'unité 3 en 1994. La plupart des prises ont été capturées par de petits chalutiers (moins de 65 pieds) utilisant des chaluts à panneaux et étaient légèrement supérieures à celles de l'année précédente, quoique bien inférieures au TAC. La pêche des petits chalutiers a commencé en avril, a atteint son plus fort en juillet et s'est terminée à la fin d'août. Au début de la saison, ces bateaux ont débarqué de très petits sébastes (moins de 20 cm), en provenance du nord et de l'est du banc de Brown, destinés à servir d'appât pour le homard, mais ils ont évité ces captures après la fin de la saison de pêche du homard. Les taux de prises commerciales ont diminué légèrement; toutefois, en raison de changements dans la pêche, ce phénomène est difficile à interpréter. La biomasse actuelle, tel qu'on peut en juger par le relevé de 1994, ne diffère pas beaucoup de la moyenne depuis la fin des années 1980, mais on a constaté un plus grand nombre de petits sébastes, en particulier au nord et à l'est du banc de Brown. Rien n'indique encore que ce recrutement aboutira à une nette amélioration de la biomasse; toutefois, combiné aux faibles taux d'exploitation actuels, il devrait se traduire en 1996 par une situation très comparable à celle des dernières années en ce qui a trait à l'état du stock et aux conditions de pêche.

Update on the status of Unit 3 redfish: 1994

Introduction

Figure 1. Unit 3 Management Area for redfish



The Unit 3 management area for redfish (Figure 1), first implemented in the 1993 Groundfish Management Plan, is located on the central and western Scotia Shelf, and consists of statistical unit areas 4Wdehkl and NAFO division 4X. Redfish in this area were previously managed as part of a larger 4VWX management area. The predominant species in Unit 3 is *Sebastes fasciatus* (Acadian Redfish), occurring in the deep basins and at the edge of the continental shelf, with *S. mentella* (Beaked Redfish) occurring in the deeper waters off the continental shelf. Differences between these two species are not readily apparent, therefore commercial and research catch are not routinely separated by species.

The 1987 4VWX redfish stock status report (Zwanenburg and Hurley 1987), and a series of previous annual reviews, established that there was inadequate scientific basis for an analytical assessment and for annual adjustment of TAC advice. The 1993 Total Allowable Catch (TAC) levels for the new management unit introduced in that year were established on the basis of the sum of the 1991 TACs for the previous units prorated by historical (1981-90) catches in the new units, giving Unit 3 a TAC of 10,000 t.

The first scientific description of Unit 3 redfish was a report to the FRCC in autumn 1993 and was used as a basis for a recommendation for the 1994 TAC also of 10,000t (FRCC 1993). The 1994 Unit 3 redfish stock status report (Branton and Halliday 1994) included a summary of fishing and research data for the period 1970 to 1993, and concluded that fishing and stock conditions in 1995 might be expected not to differ greatly from those in recent years. As a result, the TAC for 1995 was also set at 10,000 t.

This report gives a description of the 1994 Unit 3 fishery with particular attention to location and season of fishing, catch rates by vessel class, size compositions of the commercial catch and Research vessel survey results for 1994 are provided and status of the stock expected in 1995 is discussed.

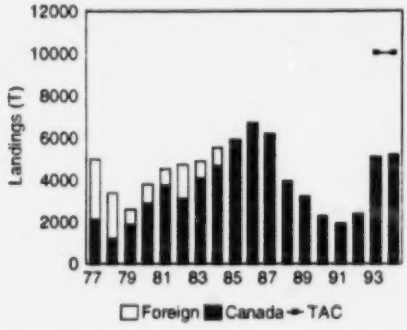
Description of the Fishery

Total Unit 3 redfish landings for 1994 were 5,179t (Table 1, Figure 2), slightly higher than 1993, but well below the 10,000t TAC. The 1993 and 94 landings were more than twice that of any year in the period 1990 to 92 which were the lowest for the period 1977 to 94.

Table 1. Unit 3 redfish Landings and TAC by Year in Thousands of Tonnes

Year	Canada	Foreign	Total	TAC
77	2.1	2.9	5.0	
78	1.2	2.2	3.4	
79	1.9	0.7	2.6	
80	2.9	0.9	3.8	
81	3.7	0.8	4.5	
82	3.1	1.6	4.7	
83	4.0	0.8	4.9	
84	4.6	0.9	5.5	
85	5.8	0.0	5.9	
86	6.6	0.1	6.7	
87	6.1	0.0	6.2	
88	3.9	0.0	3.9	
89	3.2	0.0	3.2	
90	2.2	0.0	2.3	
91	1.9	0.0	1.9	
92	2.4	0.0	2.4	
93	5.1	0.0	5.1	10.0
94	5.2	0.0	5.2	10.0

Figure 2. Canadian and Foreign Landings and TAC for Unit 3 redfish during the period 1977 to 1994



Unit 3 redfish landing occurred in all months of 1994 (Table 2), mostly in the period April to October with a peak in July. Most of the landings were from statistical unit areas 4Xmnop. More than half of the landings were from 4Xo in the period April to August where there was a peak in July. There were no landings from statistical unit areas 4Wdeh. Historically, redfish have been caught in all of the statistical unit areas of Unit 3.

Redfish can only be caught efficiently using trawl nets. The otter trawl mesh size traditionally used in the Scotian Shelf redfish fishery is about 90 mm. Neither mesh size nor minimum fish size have been subjects of regulation but the use of 90 mm mesh or larger was made mandatory in 1993 and 1994 through licence conditions. The major vessel classes involved in the Unit 3 redfish fishery during this period have been small otter trawlers (<65',Tonnage Class 2&3) and large otter trawlers(>65',Tonnage Class 4&5) (Table 3, Figure 3). Small trawlers accounted for about 4,000 t or 80% of the 1994 Unit 3 redfish landings, the highest since these vessels first entered the fishery in the early 1980s. Large otter trawlers accounted for about 1,000 t or 20% of the 1994 Unit 3 redfish landings, the lowest in the series.

Table 3. Unit 3 Canadian redfish catch by year and vessel type (main species redfish trips only) in thousands of tonnes

Year	<65'	>65'	combined
77	0.0	1.2	1.2
78	0.0	1.0	1.0
79	0.0	1.0	1.0
80	0.1	1.8	1.9
81	0.2	3.1	3.3
82	0.4	2.0	2.3
83	0.6	2.6	3.2
84	1.5	2.5	4.0
85	2.1	3.5	5.5
86	2.4	3.7	6.1
87	2.8	2.1	4.9
88	1.5	1.1	2.6
89	1.5	1.3	2.8
90	0.4	1.3	1.6
91	0.4	0.8	1.2
92	0.3	1.5	1.8
93	2.9	1.7	4.6
94	3.8	1.0	4.8

Figure 3 Unit 3 redfish catch by year and vessel type (main species redfish trips only) in thousands of tons

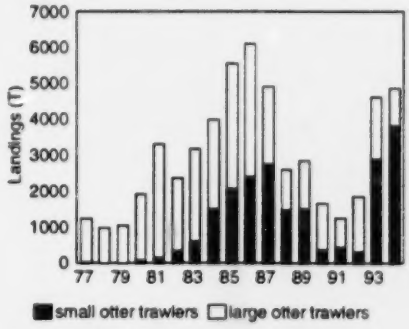


Table 2. Landed tonnes by statistical unit area and month for mobile gear fishing redfish in Unit 3 during 1994

AREA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
4Xm		1				1		146	75	57		9	289
4Xn			1	10	58	314	374	116		1		6	881
4Xo	1	1		**153**	**401**	**451**	**1064**	**546**	16	33	33	5	**2706**
4Xp		11	4	10	156	587	46	5	2	4	1	2	828
Mixed	2	16	15	19	80	50	48	56	41	10	5	20	362
sum	4	29	21	**192**	**695**	**1404**	**1532**	**869**	**133**	**105**	39	41	5066

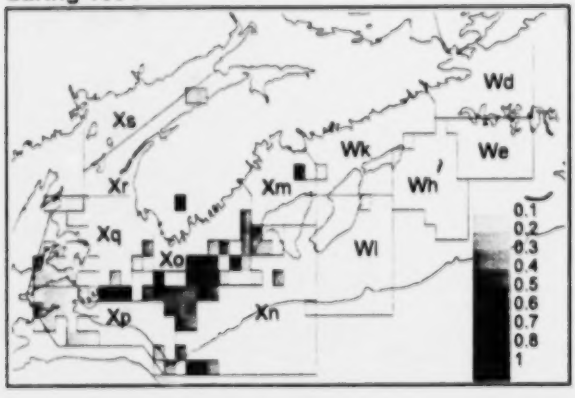
Update on the status of Unit 3 redfish: 1994

Table 4. Landed tons by vessel type, statistical unit area and month for mobile gear in Unit 3 redfish during 1994.

VESS	AREA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
<65'	4Xm								2					3
	4Xn			1	1		141	364	110				1	619
	4Xo	1	1		149	348	372	970	523	5	1		1	2373
	4Xp		11	4	10	155	565	46	5	2	4		1	803
	Mixed	1	9	15	11	72	38	34	16	1	5	5	7	215
****														
subtotal		3	22	21	171	576	1115	1414	657	7	11	5	11	4012
>65'	4Xm		1				1		144	75	57		9	286
	4Xn				9	58	174	10	6		1		5	262
	4Xo				4	53	79	94	22	11	32	33	4	333
	4Xp					2	22					1		25
	Mixed	1	7		8	7	12	14	40	41	5		13	147
****														
subtotal		2	7		21	119	288	118	212	126	95	34	31	1054

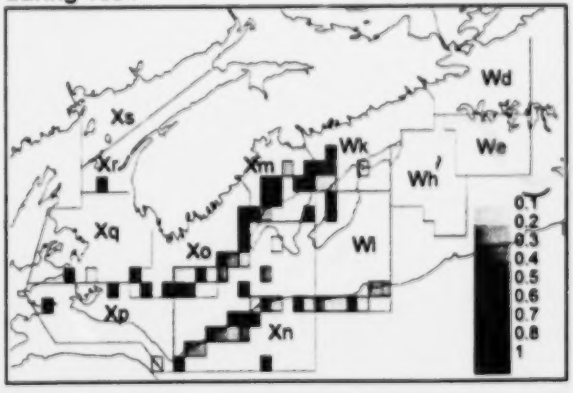
Unit 3 redfish landings by small trawlers (Table 4) were from statistical unit areas 4Xnop between April and August with a peak in July. The landings from 4Xo by small otter trawlers were between April and August with a peak in July, from 4Xp in May and June and from 4Xn in June and August. Landings by large trawlers were from statistical unit areas 4Xmno between April and December, with a peak in June. The landings from 4Xo by large otter trawlers were between May and November with a peak in July, from 4Xn in May and June and from 4Xm between August and October, peaking in August.

Figure 4. Spatial variation of small otter trawler catch rates (tons per hour) for Unit 3 redfish during 1994



The small trawlers were concentrated north and east of Brown's Bank in the area of the Western Ridge as well in the Crowell Basin and Fundian Channel (Figure 4). The best catches appeared to be coming from the Western Ridge. Fishers indicated that redfish in Crowell Basin and Fundian Channel were larger than at the Western Ridge, there was some seasonal movement of the Crowell Basin and Fundian Channel redfish, little or no movement of Western Ridge redfish and no exchange between the Western Ridge and the Fundian Channel (Industry Consultation, Yarmouth March 1995).

Figure 5. Spatial variation of large otter trawler catch rates (tons per hour) for Unit 3 redfish during 1994



The large trawlers were less concentrated than the small trawlers, fishing the Scotia Shelf edge , Emerald Basin, Lahave Basin, and the Western Ridge (Figure 5).

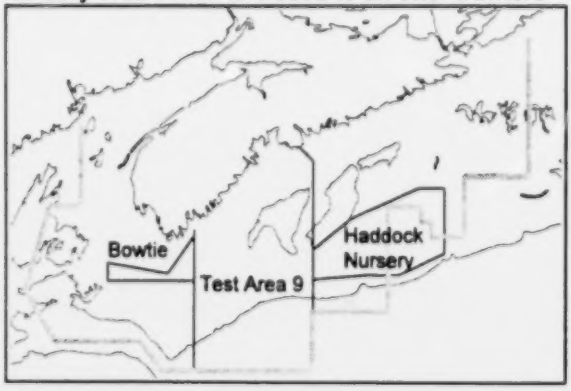
Variation Orders

Table 5. Variation Orders for Mobile < 65' Vessels fishing Unit 3 redfish During 1994

Order #	Start Date	End Date	Area/ Stock	Comment
045 046	May 4	May 18	4X	Small Fish Closure
047	May 19	June 22	4X, Western Ridge & Test Area 9	Small Fish Closure
087	Aug 31		Unit 3	Fishing Prohibited
112	Nov 5		Unit 3	Fishing may resume using 130 mm sq

On May 4, DFO closed all of NAFO Division 4X to small trawlers fishing redfish (Table 5) because some vessel owners appeared unable to control landing of small redfish for use as lobster and longline bait. Many vessel owners were requesting this closure, plus the landing of other groundfish was above 10%. Industry associations then proposed closing only the Western Ridge or Bowtie and Test Area 9 portions of 4X (Fig. 6) until observer monitored test fishing indicated that small redfish could be avoided.

Figure 6. Areas closed to small otter trawlers fishing redfish in Unit 3 during 1994 plus haddock nursery area which is closed to all otter trawlers



On May 19, DFO re-opened NAFO Division 4X and kept the Bowtie and Test Area 9 closed. On June 22 after demonstrating that small redfish could be avoided, all of 4X was re-opened to small trawlers fishing redfish . On Aug 31, Unit 3 was closed to small trawlers fishing redfish when all but 270 t of 1994 quota had been caught. There was concern that if the entire redfish quota was used up, the entire groundfish fishery would have to be closed to small trawlers because no redfish bycatch was available. On November 5, Unit 3 was opened to small trawlers fishing redfish with 130mm square mesh to use the last of the quota, however there was no fishing under these conditions (Annand and Hansen 1995).

Allocations

The Unit 3 redfish TAC for 1994 was allocated (Table 6) to three vessel types: Mobile < 65' (small trawlers), Mobile 65'-100' (large trawlers), and Vessels > 100' (large trawlers). Small trawlers were very successful, catching more than 95% percent of their quota. Both types of large trawler caught one third or less of their quota. This is about what happened last year and in the case of the large trawlers is not greatly different from their performance over the past 10 years. The overall utilization of the 1994 Unit 3 redfish TAC was 51%, due mainly to continued limited interst of the large trawlers in this fishery.

Table 6. Allocations by Vessel Type for Unit 3 redfish during 1994

Vessel Type	Quota (t)	Catch (t)	% Utilized
Mobile < 65'	3,707	3,569	96
Mobile 65' - 100'	2,673	919	34
Vessels > 100'	3,620	573	16
Combined	10,000	5,061	51

Size Composition of Commercial Catch

In 1994, 25 Unit 3 redfish samples were taken by port samplers and 115 samples were taken by at sea observers. The overall catch at length for the Unit 3 was calculated by adding estimates for various vessel types by the time of year from statistical unit area 4Xo (Appendix 1, Figure 7) to estimates for unit areas 4Xmnp and to a single estimate for unit areas 4Wdehkl and 4Xqrst combined (Appendix 2, Figure 8).

Figure 7. Commercial catch at length of redfish from 4Xo portion of Unit 3 by vessel type and time of year during 1994 indicating percentage less than 20 cm.

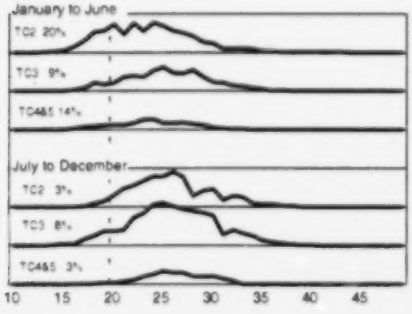
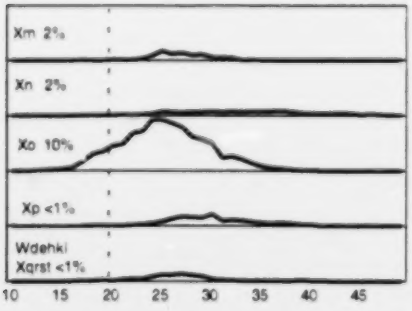
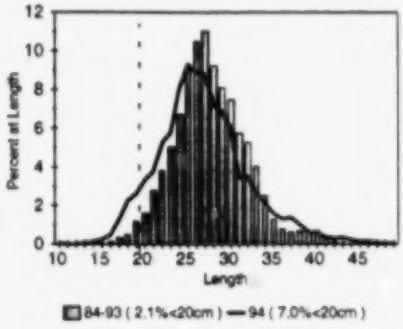


Figure 8. Commercial catch at length of redfish from Unit 3 by statistical unit area during 1994 indicating percentage less than 20 cm.



In 1994 redfish landed from Unit 3 ranged in size from 10 to 47 cm, with a mode of 25 cm (Figure 9).

Figure 9. Commercial catch size composition of Unit 3 redfish for period 1984 to 1993 and for 1994



Occurrence of Very Small Redfish

Unit 3 redfish landings have traditionally had a high proportion of fish in the 20-25 cm range, therefore the definition of very small fish for the purpose of further study was taken as being less than 20 cm. In the period 1984 to 1993 (Appendix 3, Figure 9) about 2% of the redfish landed from Unit 3 were less then 20 cm in length. In 1994, about 7.0% of the redfish from Unit 3 were less than 20 cm in length.

In 1994, the highest percentages of very small fish occurred in samples from statistical area 4Xo (Figure 8) where the content was estimated to be 10% by number and 3.1% by weight (Table 7). TC2 otter trawler landings from 4Xo during the first half of the year contained 20%very small redfish by numbers, whereas in the second half of the year after the lobster season had closed, the estimate was 3% by number. Estimates by number of very small fish in TC3 trawler landings from 4Xo were 9% in the first half of the year and 8% in the second half. Estimates by number in TC4&5 trawler landings from 4Xo were 14% in the first half of the year and 3% in the second half.

Table 7. Occurance of small redfish (< 20 cm) in Unit 3 by statistical unit area, time of year and type of vessel

Area	Months	Tonnage Class	Landed Tons	Number of Samples Lnd/Obs	Average Length		Percent of fish less than 20cm (8 inches)	
					cm	in	By Number	By Weight
4Xm	All	All	319	1/3	26	10	2	0.6
4Xn	All	All	833	3/19	31.7	13	2	0.3
4Xo	Jan to Jun	2&3	877	7/18	23.4	9	16	7.9
		4&5	138	1/7	24	9	14	5.2
	Jul to Dec	2&3	1509	5/36	25.9	10	6	1.1
		4&5	199	1/3	26.2	10	3	1
	All	All	2714	14/64	24.2	9	10	3.1
4Xp	All	All	832	3/13	29.2	11	less than 1	less than .01
Mixed	All	All	428	4/16	26.4	10	4	1.1
All	All	All	5176	25/115	25	10	7	1.8

Resource Status

Catch Rate

Table 8. Catch, Effort, and Catch per Unit of Effort by vessel type and year for Unit 3 redfish

	Small Otter Trawlers			Large Otter Trawlers		
Year	Catch	Effort	CPUE	Catch	Effort	CPUE
1982	365	750	0.5	2013	2381	0.8
1983	631	839	0.8	2859	2788	1.0
1984	1534	2532	0.6	2456	1652	1.5
1985	2075	2537	0.8	3471	2033	1.7
1986	2385	3938	0.6	3649	3683	1.0
1987	2712	4672	0.6	2492	2218	1.1
1988	1434	2510	0.6	1694	1775	1.0
1989	1391	1872	0.7	1371	1275	1.1
1990	353	1004	0.4	1410	692	2.0
1991	433	658	0.7	1005	1279	0.8
1992	321	1305	0.2	1500	1566	1.0
1993	2887	5125	0.6	1716	2009	0.9
1994	3847	9759	0.4	1015	1783	0.6

Catch rates for large and small otter trawlers declined over the period 1982 to 1994 (Table 8). The small otter trawler catch rate was 0.4 tons per hour (tph) in 1994, slightly less than the 5 year average annual rate of 0.5 tph, while the large otter trawler catch rate was 0.6 tph, substantially less than the 5 year average of 1.1 tph.

Fishers indicated that this slight reduction in catch rates for < 65' vessels may have been due to the small fish closures in statistical unit area 4Xo during May and June (Industry Consultation, Yarmouth March 1995). The <65' vessels accounted for over 80% of the 1994 redfish landings from Unit 3.

An inital analysis of catch and effort data provided unreasonable results for the >65' vessels. A close look at the commercial landings effort data revealed a subtrip which had 990 effort hours for 2 fishing days and another which had 680 effort hours for .2 fishing days. Live weight for these two substrips was 5 tons. Staff at Statistics indicated that this was an entry error on a field for which there was no quality control processing. These erroneous data were removed

before calculating Table 5, but the lack of quality control on effort data cast doubt on the reliability on the remaining data also.

Research Survey Stock Size Estimates

Survey estimates of population size indicate that the population has been quite stable in biomass and abundance since the late 1980s (Table 9, Figure 10). The semi-pelagic nature of redfish and limited depth range of the Scotia Fundy summer surveys (200 fm) suggests that actual stock biomass is higher than the survey estimates.

Table 9. Survey Biomass (tonnes) and Abundance (numbers per standard tow) estimates for Unit 3 redfish from Scotia Fundy Summer Research Survey

	Biomass		Abundance	
Year	Annual Estimate	5 Year Average	Annual Estimate	5 Year Average
1982	72.7		76.5	
1983	122.7		121.3	
1984	106.0		90.1	
1985	17.0		18.0	
1986	93.2	82.3	71.7	75.5
1987	63.1	80.4	57.5	71.7
1988	83.4	72.5	91.1	65.7
1989	28.1	57.0	29.5	53.5
1990	61.7	65.9	84.3	66.8
1991	24.9	52.2	38.3	60.1
1992	116.0	62.8	119.6	72.6
1993	69.6	60.1	75.5	69.4
1994	50.4	64.5	80.1	79.6

Given redfish longevity and survey variability a running average of the 5 most recent years was calculated to further illustrate biomass trends. The research survey series prior to 1982 have not been included due to vessel changes and associated uncertainties over appropriate conversion factors.

Survey mean numbers/ tow shows a trend towards higher abundance starting in the late 1980s and continuing to 1994 (fig 11). In 1994, the mean numbers per tow increased to 80 fish per tow from 76 fish per tow in 1993, above the 10 year average of 67 fish per tow.

Figure 10. Biomass for Unit 3 redfish from Scotia Fundy Summer Research Vessel Survey

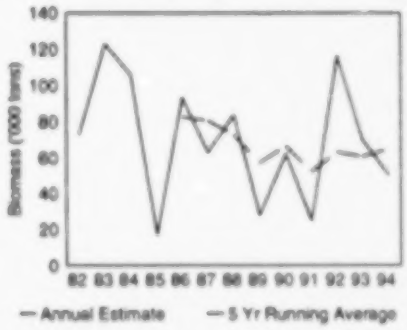
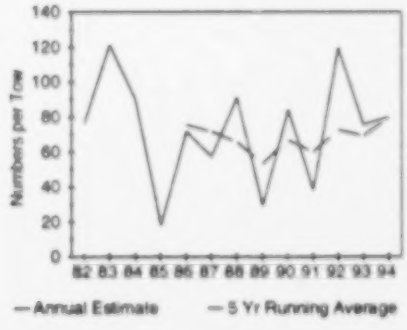


Figure 11. Abundance (numbers per standard tow) for Unit 3 redfish from Scotia Fundy Summer Research Vessel Survey



Research Vessel Survey Size Compositions

There were two readily observable modes in the length frequency from the 1994 summer survey, one at 25 cm and another at 13 cm (Appendix 4, Figure 12). The mode at 25 cm has generally been observed throughout the history of the survey whereas the 13 cm mode has occurred only sporadically (Figure 13). In 1994, this mode of smaller fish occurred almost exclusively in and around the 4Xo statistical unit area. Previous occurrences of small fish have occurred elsewhere in Unit 3 and there have also been cases of modes of large fish occurring in and around 4Xo.

Figure 12. Population size composition for Unit 3 redfish from Scotia Fundy Summer Survey for 1994

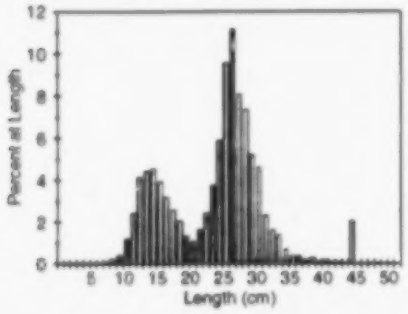


Figure 13. Size composition of survey catches for Unit 3 redfish from Scotia Fundy Summer Research Vessel Survey for the period 1982 to 1994

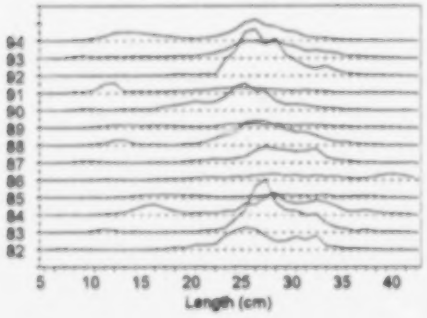


Figure 14. Numbers of Unit 3 redfish by size category and year from Scotia Fundy Summer Research Survey

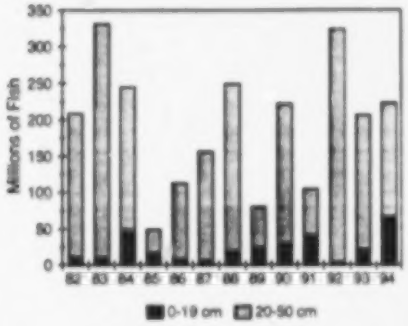
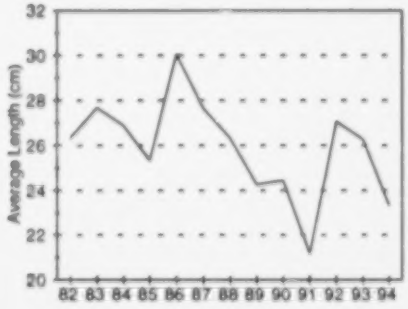


Figure 15. Average length of Unit 3 redfish by year from Scotia Fundy Summer Research Vessel Survey



Recruitment

The size compositions of survey catches in the late 1980s and the early 1990s provide some evidence of small fish entering the population (Figure 14). A decline in the average length of fish in the survey catches after 1986 supports this indication that some recruitment occurred in the period (Figure 15). The 1994 survey in particular showed the presence of moderate numbers of fish less than 20 cm long in the population.

Size at Maturity

There have been no directed studies regarding the growth rate and average size or age at maturity of Unit 3 redfish. However in the Gulf of Maine, which is adjacent to the main concentrations of redfish in Unit 3 , *S. fasciatus* females are 50% mature at a length of about 22 cm (Mayo 1993). This is smaller than the same species in the Laurentian Channel where females are 50% mature at between 25 and 28 cm (Atkinson *et al.* 1995).

Distribution

The population continues to be widely distributed in all deep water areas of the management unit. The occurrence of small redfish less than 20 cm long in survey catches is also widespread. There are concurrent concentrations of both large and small fish north and east of Brown's Bank in the same area as encountered by the commercial fishery. There are concentrations of large fish on the inshore slope of LaHave and Emerald Basins and in the Fundian Channel without corresponding concentrations of smaller fish (Appendix 5).

Harvest Rate

A harvest rate (calculated as the ratio of commercial catch to survey biomass) of 0.15 was adopted for redfish by CAFSAC in 1979 as an approximation to fishing at $F_{0.1}$ when this reference point could not be calculated. Harvest rate estimates were in the 0.10 to 0.20 range in the early 1970s, the actual value depending on assumptions about catch levels in that period, but have not exceeded 0.08 for the more recent period of 1986 to 1994 (Table 10).

Table 10. Harvest rate of Unit 3 redfish for the period 1986 to 1994

	Annual Landings	5yr Avg Biomass	Harvest Rate
86	6.7	82.3	0.08
87	6.2	80.4	0.08
88	3.9	72.5	0.05
89	3.2	57.0	0.06
90	2.3	65.9	0.03
91	1.9	52.2	0.04
92	2.4	62.8	0.04
93	5.1	60.1	0.08
94	5.2	64.5	0.08

Conclusions

The increase in catches for 1993 and 1994, compared to 1992, resulted from an increase in fishing effort, reflecting decreased fishing opportunities for more valuable species.

Commercial catch rates have declined slightly over the last five years but many changes in the fishery make these difficult to interpret in the context of redfish abundance. Research vessel surveys indicate stability in the population biomass and suggest some improvement in recruitment in recent years. There is, as yet, no indication that this recruitment will result in a marked increase in the biomass but combined with the low exploitation rates which currently prevail, should result in fishing and stock conditions in 1996 being very much the same as in recent years. Catches of 10,000 t in 1995 and 1996 would be consistent with the currently established 15% target harvest rate.

It appears that fishing in 1994 was directed towards small fish because of their accessability and a ready market and that these catches could be avoided when required.

Acknowledgements

The author acknowledges with thanks, the valuable technical assistance of Kirsten Clark, who performed many of the computerized analyses.

References

Annand C. and J. Hansen 1995, Management Activities for 1994 and Early 1995 in the Scotia Fundy Region, DFO Atlantic Res. Doc. 94/45, 31 p

Atkinson, D.B. *et al.* 1995, Summary Report of the Zonal Working Group on Redfish in Units 1, 2, 3, and Division 3O. Unpublished, May 95, 19 p..

Branton, R.M. and R.G. Halliday 1994. Unit 3 Redfish Population and Fishery Trends. DFO Atlantic Res. Doc. 94/38, 33 p.

FRCC. 1993. Appendix 4: Update on redfish from the Science Sector of the Department of Fisheries and Oceans, 18 p. [In] report to the Minister of Fisheries and Oceans, November 1993. Fisheries Research Conservation Council, Ottawa, Misc. Publ. 70 p + appendices.

Mayo, R.K. 1993. Historic and recent trends in the population of redfish, *Sebastes fasciatus* Storer, in the Gulf of Maine-Georges Bank region. Northeast Fisheries Center Reference Doc. No. 93-03: 24 p

Zwanenburg, K. and P.C.F. Hurley 1987. Redfish (*Sebastes* spp.) in Management unit 4VWX: and assessment of present stock status. CAFSAC Res. Doc. 87/35, 34 p.

Appendix 1. Landed numbers at length of Unit 3 redfish by tonnage class and time of year for statistical unit area 4Xo in 1994

	January to June				July to December				All Months
Length (cm)	TC2	TC3	TC2+3	TC4+5	TC2	TC3	TC2+3	TC4+5	TC2-5
10	0	0	0	0	0	2191	2191	0	2191
11	0	0	0	0	0	163	163	0	163
12	0	0	0	0	0	0	0	0	0
13	2478	2144	4622	0	0	0	0	0	4622
14	5817	2175	7993	946	0	4637	4637	0	13575
15	11597	2230	13827	3191	0	11138	11138	284	28440
16	37735	7699	45434	8038	0	11161	11161	74	64708
17	75908	19045	94953	18839	4063	41153	45216	5619	164627
18	133709	52315	186024	23361	24736	62693	87429	4288	301101
19	138639	42294	180934	26508	37819	94430	132249	9910	349601
20	179224	54609	233833	31756	74566	95639	170205	10546	446339
21	119057	90391	209448	33190	120332	102418	222750	17638	483026
22	187568	99749	287317	44484	141184	181318	322502	26319	680623
23	136494	89534	226028	63334	170876	211825	382701	48846	720909
24	190353	132276	322629	69317	199497	268120	467616	66054	925615
25	169978	155584	325562	40897	198782	275287	474069	86228	926757
26	139084	118522	257606	42721	227939	256713	484651	76503	861482
27	123776	112918	236694	46654	195433	235490	430923	74493	788763
28	105711	134666	240377	37706	70502	224298	294801	51068	623951
29	66450	93509	159959	30350	107428	214937	322365	50789	563463
30	56666	57999	114665	11682	116983	195603	312586	51106	490040
31	23345	55493	78838	9856	45409	71610	117019	36597	242310
32	24752	36679	61431	6565	70502	102505	173008	23983	264986
33	23366	32762	56128	5344	63270	80188	143458	2276	207206
34	19358	21370	40727	1788	24915	65470	90385	2564	135464
35	8879	12565	21445	2701	20673	36476	57149	948	82244
36	5589	1686	7276	785	20852	23852	44704	0	52765
37	2930	6757	9687	989	8484	15476	23960	97	34733
38	2203	1740	3943	362	8305	8229	16534	291	21131
39	1444	464	1908	349	0	3425	3425	0	5683
40	498	152	650	275	0	6064	6064	0	6988
41	124	0	124	106	0	1890	1890	0	2120
42	178	0	178	157	0	97	97	0	432
43	124	0	124	63	0	0	0	0	187
44	0	0	0	31	0	0	0	0	31
45	0	0	0	31	0	0	0	0	31
46	0	0	0	63	0	0	0	0	63
47	0	0	0	31	0	0	0	0	31
48	0	0	0	31	0	0	0	0	31
49	0	0	0	0	0	0	0	0	0
total->	1993033	1437329	3430362	562504	1952549	2904498	4857048	646522	9496435

Appendix 2. Landed numbers at length by statistical unit area for Unit 3 redfish in 1994

Length	4Xm	4Xn	4Xo	4Xp	4Wdehkl 4Xqrst	Total	% at length
10	0	0	2191	0	0	2191	0.01
11	0	0	163	0	0	163	0.00
12	155	0	0	0	0	155	0.00
13	0	104	4622	0	0	4726	0.03
14	0	0	13575	394	0	13969	0.10
15	2660	0	28440	0	2848	33948	0.23
16	3066	0	64708	0	2874	70648	0.48
17	7869	7020	164627	0	8516	188032	1.28
18	5367	14039	301101	0	9120	329627	2.25
19	3174	8784	349601	394	25504	387456	2.64
20	7589	10562	446339	7454	17415	489359	3.34
21	10997	17592	483026	8455	34846	554915	3.78
22	17287	15930	680623	16376	46085	776301	5.29
23	31864	21936	720909	25437	48345	848490	5.78
24	89263	30202	925615	47598	86287	1178965	8.04
25	167166	74742	926757	78620	118714	1365998	9.31
26	120480	66952	861482	131215	123258	1303387	8.88
27	138837	47868	788763	175316	136150	1286934	8.77
28	101721	62181	623951	158523	119790	1066167	7.27
29	114813	69971	563463	155570	97926	1001744	6.83
30	54941	76260	490040	218985	42492	882718	6.02
31	52389	69393	242310	105988	38673	508754	3.47
32	42690	70704	264986	108824	26895	514098	3.50
33	2628	61753	207206	100793	16899	389280	2.65
34	9390	75497	135464	76898	16876	314126	2.14
35	280	77288	82244	58769	13184	231765	1.58
36	0	75840	52765	45131	13341	187078	1.28
37	0	88196	34733	57974	15774	196679	1.34
38	0	59947	21131	47249	15041	143368	0.98
39	0	39076	5683	30428	18005	93191	0.64
40	0	34816	6988	25427	15645	82877	0.56
41	0	31908	2120	7380	10941	52349	0.36
42	0	33550	432	4954	5426	44362	0.30
43	0	39598	187	3018	3245	46049	0.31
44	0	25892	31	1460	1859	29243	0.20
45	0	10546	31	2190	1732	14500	0.10
46	0	19411	63	1564	487	21526	0.15
47	0	9039	31	313	218	9601	0.07
48	0	2202	31	521	572	3326	0.02
49	0	1000	0	417	64	1481	0.01
total->	984627	1349798	9496435	1703636	1135047	14669544	100

Appendix 3. Landed numbers at length by year for Unit 3 redfish during the period 1982 to 1994

length	82	83	84	85	86	87	88	89	90	91	92	93	94	total	%at length
10	0	0	0	0	0	0	0	0	0	0	0	0	2191	2191	0.00
11	0	0	0	0	0	0	0	0	0	0	0	0	163	163	0.00
12	0	0	0	0	0	0	0	0	0	0	0	0	155	155	0.00
13	0	0	0	0	0	0	0	0	0	0	0	0	4726	4726	0.00
14	0	0	0	0	0	0	0	0	0	0	0	40403	13969	54372	0.04
15	0	0	0	0	3748	0	0	0	0	0	0	9218	33948	46914	0.03
16	0	0	0	0	9216	0	27037	0	0	63658	0	18437	70648	188997	0.12
17	0	0	0	10347	10619	17999	2098	0	0	254632	0	64718	188032	548445	0.36
18	2696	0	0	13504	60845	6244	0	48374	34063	305428	0	69852	329627	870634	0.57
19	19766	10164	5373	26480	146340	138186	83608	78016	71328	470677	0	309759	387456	1747154	1.15
20	113430	21223	10816	114832	226470	224733	88203	98285	74167	585012	0	386306	489359	2432836	1.60
21	128064	50071	39353	123263	378900	676207	72056	282421	173134	1077314	6587	293297	554915	3855584	2.54
22	83263	218119	115768	103065	409621	916242	389954	676799	226019	528274	19757	891765	776301	5354950	3.53
23	178773	221401	178233	250129	463434	1146121	449184	1304709	559483	598335	19757	708822	848490	6926871	4.57
24	541320	469469	402535	677359	612746	1418164	521786	1315027	896188	371633	6587	1321259	1178965	9733037	6.42
25	1087373	816819	862131	1640184	853272	1939479	755977	1290420	1232574	434951	16112	1303882	1365998	13599172	8.97
26	1564746	1340619	1432136	1896341	1305191	2193393	1060447	1305253	1018882	433629	35869	1138913	1303387	16028805	10.57
27	1900992	1611112	1650530	2291476	1281983	2072377	995034	1242903	1222581	470373	72448	1140422	1286934	17239166	11.37
28	1426372	1403302	1957727	1805524	1181624	1562054	658147	745804	553790	430450	191754	1297951	1066167	14280666	9.42
29	1076906	1346300	1249982	1809771	1020330	1510764	641082	623524	324458	368291	205634	1327919	1001744	12506705	8.25
30	1093090	1045632	1396997	1600996	1126778	1506534	795306	320221	189354	284143	202266	981574	882718	11425609	7.54
31	1178354	891381	1384241	1141041	860169	975809	388750	412059	237260	175579	192387	693649	508754	9039433	5.96
32	941930	943238	1271715	904073	742203	862299	543181	332527	253808	118501	244177	653517	514098	8325266	5.49
33	558886	616795	817146	632535	510522	460396	459896	291957	165823	183874	306420	687416	389260	6080945	4.01
34	153546	379657	462570	365490	263828	253400	379181	148977	87037	187246	273579	396437	314126	3665074	2.42
35	83083	206047	133231	188680	154466	167640	264488	51964	25674	75413	225082	123313	231765	1930847	1.27
36	103499	146054	61697	29990	106587	144487	116487	12105	23262	68738	191154	106141	187078	1297278	0.86
37	30025	128639	25564	5795	126510	65153	89231	11166	6130	14347	178478	156490	196679	1034206	0.68
38	23961	65059	20677	1932	267944	4581	106656	7044	5770	13434	183106	110558	143368	954090	0.63
39	5907	22959	11433	1932	174223	9633	104998	3166	2164	0	289142	80993	93191	799741	0.53
40	4075	9124	5602	0	228581	471	124819	4215	361	0	354440	25004	82877	839567	0.55
41	1528	2677	2532	0	146896	314	64186	1461	361	0	165467	0	52349	437770	0.29
42	764	1004	0	0	0	157	38149	2510	0	0	85511	0	44362	172458	0.11
43	236	4800	0	0	0	0	0	731	0	0	33330	871	46049	86016	0.06
44	0	1004	0	0	0	0	0	0	0	0	2804	0	29243	33051	0.02
45	0	0	0	0	0	0	0	0	0	0	0	0	14500	14500	0.01
46	0	0	0	0	0	0	0	0	0	0	0	0	21526	21526	0.01
47	0	0	0	0	0	0	0	0	0	0	0	0	9601	9601	0.01
total->	12302584	11972670	13497991	15634738	12673044	18272838	9219940	10611641	7383670	7513934	3501847	14338887	14664736		

Appendix 4. Population numbers at length of redfish by year for Unit 3 during the period 1982 to 1994 (hundred thousar

length	82	83	84	85	86	87	88	89	90	91	92	93	94	% at length 94
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
5	2.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0
6	4.7	0.0	0.0	0.0	0.0	0.2	0.0	1.7	0.0	1.1	0.2	0.8	0.4	0.0
7	8.8	0.1	1.3	0.0	0.7	1.5	0.5	2.8	1.1	0.5	0.2	3.2	1.5	0.1
8	6.6	1.7	1.1	0.3	2.0	6.2	1.6	1.6	5.9	10.0	0.1	13.7	4.5	0.2
9	6.0	3.4	0.0	0.9	2.2	15.0	6.0	4.5	18.1	9.1	0.6	25.5	8.6	0.4
10	4.3	13.1	3.2	1.7	5.2	14.1	11.6	11.8	13.7	37.5	2.6	11.8	25.7	1.2
11	3.2	32.8	9.0	0.3	9.1	8.1	20.6	21.8	7.3	104.8	4.7	15.4	53.2	2.4
12	3.4	20.7	11.8	3.1	7.6	1.3	57.4	29.6	6.4	116.2	2.5	15.5	91.5	4.1
13	2.3	6.1	28.6	5.0	5.3	5.2	60.6	31.5	11.7	17.0	1.7	14.8	97.5	4.4
14	1.9	8.0	67.1	15.9	5.6	2.1	16.9	32.9	14.5	17.9	0.7	20.8	100.0	4.5
15	2.3	4.5	107.9	25.8	5.5	3.1	7.8	22.2	9.2	18.0	3.9	18.3	87.0	3.9
16	6.2	1.6	121.3	30.1	9.4	2.9	7.0	26.7	17.4	16.3	4.0	17.0	70.0	3.1
17	6.8	5.1	78.5	33.6	11.9	4.2	4.2	29.0	47.1	14.6	2.2	15.8	56.8	2.6
18	26.7	4.4	44.5	31.5	17.1	5.4	3.7	22.3	61.7	21.6	13.4	23.0	45.1	2.0
19	22.1	6.1	18.2	22.1	15.7	10.3	12.2	18.2	82.4	26.3	13.8	21.3	29.0	1.3
20	57.0	3.9	16.2	20.5	24.9	22.9	12.0	12.1	106.6	31.0	6.8	24.2	23.7	1.1
21	56.2	19.4	25.5	14.2	34.2	33.7	39.3	13.8	90.1	37.9	16.4	44.2	35.8	1.6
22	66.9	25.8	20.7	6.8	34.2	44.4	82.2	16.2	101.0	49.4	13.7	64.3	52.9	2.4
23	164.9	54.1	44.7	4.0	30.7	39.5	121.4	35.3	158.1	59.5	184.4	98.5	82.7	3.7
24	217.2	153.3	47.6	3.8	39.4	48.8	167.7	43.8	262.7	59.3	282.8	151.7	130.6	5.9
25	254.5	257.6	129.3	7.3	39.3	72.6	258.9	38.6	308.6	58.2	500.6	195.6	211.7	9.5
26	237.2	535.6	119.3	10.1	56.0	144.9	278.2	50.0	227.1	57.5	537.8	197.3	247.6	11.1
27	160.5	606.7	210.6	20.4	64.6	183.6	278.1	31.1	220.9	49.6	361.5	171.8	179.1	8.1
28	99.7	341.4	248.8	25.3	73.4	159.1	229.5	39.2	112.5	43.8	422.3	190.5	163.0	7.3
29	102.8	254.5	158.3	29.4	50.8	147.7	185.8	34.5	69.5	31.5	240.5	157.0	115.3	5.2
30	151.0	248.9	134.0	25.1	61.2	129.7	154.9	32.4	73.6	24.5	176.5	133.2	102.6	4.6
31	115.2	197.8	139.8	21.5	40.2	140.5	152.9	40.5	61.5	35.3	111.6	83.5	51.4	2.3
32	164.5	212.0	173.2	23.8	53.9	164.8	111.1	33.4	38.9	27.5	81.1	91.1	35.7	1.6
33	43.5	106.8	143.9	29.9	41.0	64.9	71.0	26.2	24.3	18.8	109.5	73.1	29.9	1.3
34	32.8	60.8	104.6	10.6	45.5	37.4	42.0	18.9	24.2	7.3	60.5	63.8	14.9	0.7
35	11.7	43.5	47.1	11.1	25.7	27.2	38.1	16.1	9.6	5.9	30.2	28.9	8.2	0.4
36	12.8	10.9	42.2	14.3	16.6	9.6	20.6	10.8	11.0	3.7	16.4	24.3	7.7	0.3
37	11.2	31.7	57.5	13.2	22.9	6.1	11.4	10.6	5.9	7.4	7.1	13.9	3.4	0.2
38	9.1	11.2	36.2	15.8	47.3	3.7	10.3	12.1	2.7	5.1	7.1	11.8	5.5	0.2
39	2.5	11.8	24.3	6.4	71.1	1.3	4.0	9.6	3.4	7.0	5.9	8.7	1.7	0.1
40	4.8	7.5	16.3	4.1	69.3	1.1	3.6	8.4	1.2	5.0	6.5	6.2	2.9	0.1
41	2.7	4.9	12.5	1.1	51.7	0.8	1.8	3.8	2.4	1.9	0.2	0.0	1.1	0.1
42	0.7	3.4	0.8	0.5	25.1	0.3	0.5	4.3	0.4	1.5	0.8	3.3	1.1	0.1
43	0.8	0.8	1.2	0.2	10.8	0.2	0.5	2.8	0.5	2.2	0.8	0.0	0.7	0.0
44	0.5	0.3	0.2	0.7	2.4	0.3	0.0	0.3	0.0	0.3	1.2	2.7	44.5	2.0
45	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.9	0.0	0.0	0.0	0.0
46	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	1.2	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0-50 cm	2088	3313	2449	491	1129	1565	2486	803	2213	1043	3253	2057	2225	
0-19 cm	107	108	492	171	97	80	210	257	297	411	51	217	671	
20-50 cm	1981	3205	1956	320	1032	1486	2276	546	1917	632	3182	1839	1554	
Avg Len	26.3	27.7	26.9	25.3	30.0	27.7	26.3	24.3	24.4	21.2	27.1	26.3	23.3	